**Summary of Evaluation with City Council-Adopted Criteria**

**Meadow / Charleston**

### Evaluation Criteria

- **Trench**
  - **Facilitate movement across the corridor for all modes of transportation**
    - Meadow Dr and Charleston Rd will be grade separated from the railroad at all modes and will remain open.
    - Meadow Dr and Charleston Rd will be grade separated from the railroad for all modes and will remain open.
    - Meadow Dr and Charleston Rd will be grade separated from the railroad for all modes and will remain open.
  - **Reduce delay and congestion at vehicular traffic at rail crossings**
    - With construction of the grade separation, the railroad crossings and warning lights at Meadow Dr and Charleston Rd will be removed. Thus, the traffic will not be interrupted by railroad crossings.
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    - With construction of the grade separation, the railroad crossings and warning lights at Meadow Dr and Charleston Rd will be removed. Thus, the traffic will not be interrupted by railroad crossings.
  - **Provide clear, safe routes for pedestrians and cyclists crossing the rail corridor, separate from vehicles**
    - Pedestrian/cyclists that will be separated from train traffic and bike lanes will be added to Meadow Dr.
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- **Hybrid**
  - **Facilitate movement across the corridor for all modes of transportation**
    - Meadow Dr and Charleston Rd will be grade separated from the railroad at all modes and will remain open.
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- **Viaduct**
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- **South Polo Alto Tunnel**
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- **Underpass**
  - **Facilitate movement across the corridor for all modes of transportation**
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### Summary

**Order of Magnitude Cost**

<table>
<thead>
<tr>
<th>Trench</th>
<th>Hybrid</th>
<th>Viaduct</th>
<th>South Polo Alto Tunnel Passenger and Freight</th>
<th>South Polo Alto Tunnel Air Freight</th>
<th>Underpass</th>
</tr>
</thead>
<tbody>
<tr>
<td>$800M to $950M*</td>
<td>$200M to $250M*</td>
<td>$400M to $500M*</td>
<td>$1,184M to $1,827M*</td>
<td>$1,737M to $1,795M*</td>
<td>$350M to $450M*</td>
</tr>
</tbody>
</table>

* Total Preliminary Construction Cost for infrastructure of both railroad crossings in 2018 dollars with escalation to 2025 (Subject to Change).

June 26, 2020
# Summary of Engineering Challenges

<table>
<thead>
<tr>
<th>Engineering Challenges</th>
<th>Meadow / Charleston</th>
<th>South Palo Alto Tunnel Passenger and Freight</th>
<th>South Palo Alto Tunnel with At-Grade Freight</th>
<th>Underpass</th>
</tr>
</thead>
</table>
| L Creek/Drainage Impacts | - Requires diversion of Adobe and Matadero creeks resulting in the need for pump stations.  
- Numerous regulatory agency approvals required for creek diversion.  
- Pump stations also required to dewater the trench.  
- Increased risk of flooding due to pump stations.  
- Pumps are required for lowerend roadways.  
- Increased risk of flooding due to pump stations.  
- No significant creek or drainage impacts.  
- Requires diversion of Adobe and Matadero creeks resulting in the need for pump stations.  
- Numerous regulatory agency approvals required for creek diversion.  
- Pump stations also required to dewater the trench and tunnel.  
- Increased risk of flooding due to pump stations.  
- Requires diversion of Adobe and Matadero creeks resulting in the need for pump stations.  
- Numerous regulatory agency approvals required for creek diversion.  
- Pump stations also required to dewater the trench and tunnel.  
- Increased risk of flooding due to pump stations.  
- Pump station required for lowered roadways.  
- Increased risk of flooding due to pump station. | | | |
| M Long-Term Maintenance | - Increased maintenance costs due to:  
- Pump stations for creek diversions.  
- Pump stations for trench dewatering.  
- Above ground railroad alignment with embankments and viaduct structures.  
- Increased maintenance costs due to:  
- Pump stations for creek diversions.  
- Pump stations for trench dewatering.  
- Below ground railroad alignment.  
- Increased maintenance costs due to:  
- Pump stations for creek diversions.  
- Pump stations for trench dewatering.  
- Below ground railroad alignment as well as at-grade railroad alignment.  
- Increased maintenance cost due to:  
- Pump stations for underpass dewatering.  
- Above ground structures for both road and rail. | | | |
| N Utility Relocations | - Major utility relocations for lowered railroad.  
- Major utility relocations for lowered roadways.  
- No major utility relocations.  
- Major utility relocations for lowered railroad.  
- Major utility relocations for lowered roadways. | | | |
| O Railroad Operations Impacts during Construction | - Temporary track (i.e., shoofly) is required.  
- Temporary track (i.e., shoofly) is required, but a bit shorter than the trench shoofly.  
- Temporary track (i.e., shoofly) is required.  
- Temporary track (i.e., shoofly) is likely required unless an alternate construction methodology and sequencing is acceptable to Caltrain. | | | |
| P Local Street Circulation Impacts during Construction | - Removal of right turn lanes on Alma St at Meadow Dr and Charleston Rd; however, traffic will still be able to flow as needed despite lane reduction.  
- Closed Meadow Dr while Charleston Rd roadway bridges are constructed and visa versa.  
- Reduced lane widths on Alma St, north of Meadow Dr and south of Charleston Rd.  
- Possible night time closures of Meadow Dr and Charleston Rd.  
- Alma St will be reduced to one lane in each direction from south of Oregon Expressway to Ventura Ave.  
- From Charleston Rd to Ferne Ave, there will be only one southbound lane on Alma St.  
- Lane reduction on Alma St during construction of the shoofly and bridge.  
- Closure of Meadow Dr and Charleston Rd throughout excavation and construction of the undercrossing and related features. | | | |
| Q Caltrain Design Exceptions Needed | 2% grade on track required. Maximum grade allowed by Caltrain is 1%.  
- Temporary vertical clearance of 12 feet at undercrossing structures during construction. Minimum vertical clearance allowed by Caltrain is 15.5 feet. | 1.4% grade on track required. Maximum grade allowed by Caltrain is 1%. | 2% grade on track required. Maximum grade allowed by Caltrain is 1%. | No Caltrain design exceptions required. |
## Summary of Evaluation with City Council-Adopted Criteria

### Churchill

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Churchill Ave will be closed to vehicles at the railroad tracks.</th>
<th>Churchill Ave will be grade separated from the railroad for all modes and will remain open. Viaduct provides opportunities for additional crossings for all modes.</th>
<th>Churchill Ave will be grade separated from the railroad for all modes and will remain open. Through traffic on Churchill Ave is no longer possible, and some traffic will have to take alternate routes. Pedestrian/bike (only) traffic will be grade separated from the railroad and vehicle traffic via Alma St via an undercrossing at Kellogg Ave.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Facilitate movement across the corridor for all modes of transportation</td>
<td>With closure of Churchill Ave, the traffic at nearby intersections will be impacted; however, this can be mitigated.</td>
<td>With construction of the grade separation, the railroad crossing gate and warning lights at Churchill Ave will be removed. Thus, the traffic will not be interrupted by railroad crossing gates.</td>
<td>With construction of the grade separation, the railroad crossing gate and warning lights at Churchill Ave will be removed. Thus, the traffic will not be interrupted by railroad crossing gates.</td>
</tr>
<tr>
<td>B Reduce delay and congestion for vehicular traffic at rail crossings</td>
<td>Pedestrians/cyclists will be separated from train traffic and vehicles.</td>
<td>Pedestrians/cyclists will be separated from train traffic.</td>
<td>Pedestrians and cyclists will be completely separated from train and vehicular traffic. Full Pedestrian and cyclist movement is maintained with the crossing relocated to Kellogg Ave.</td>
</tr>
<tr>
<td>C Provide clear, safe routes for pedestrians and cyclists crossing the rail corridor, separate from vehicles</td>
<td>A temporary railroad track will not be required.</td>
<td>The viaduct would require substantial local funding resources significantly above the closure alternative.</td>
<td>The underpasses would require lower levels of local funding, substantial portion of the capital costs would be covered by regional, state and federal sources.</td>
</tr>
<tr>
<td>D Support continued rail operations and Caltrain service improvements</td>
<td>The closure would require the lowest levels of local funding, with a substantial portion of capital costs covered by Regional, State and Federal sources.</td>
<td>A temporary railroad track will be required. Stanford game day station will be eliminated due to grade issues.</td>
<td>A temporary railroad track is likely to be required unless an alternate construction methodology and sequencing is acceptable to Caltrans.</td>
</tr>
<tr>
<td>E Finance with feasible funding sources</td>
<td>No acquisition of private properties is required; however, there will be impacts to Palo Alto High School property and potentially Caltrain. There also may be some parking loss on the east side of Churchill Ave for the pedestrian/bike undercrossing (Option 2 only).</td>
<td>No acquisition of private properties will be required.</td>
<td>Driveaway modifications are likely to be required due to the removal of planter strips along Alma St. Some (silver) acquisition of the high value and/or residential property fronting Churchill Ave on the inside of the tracks will be required. Some of the proposed improvements require encroachment inside Caltrain's right-of-way, especially during construction.</td>
</tr>
<tr>
<td>F Minimize right-of-way acquisition</td>
<td>A temporary railroad track will be required. Stanford game day station will be eliminated due to grade issues.</td>
<td>The viaduct would require substantial local funding resources significantly above the closure alternative.</td>
<td>The underpasses would require lower levels of local funding, substantial portion of the capital costs would be covered by regional, state and federal sources.</td>
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<tr>
<td>G Reduce rail noise and vibration</td>
<td>Train horn noise and warning bells will be eliminated with the removal of the at-grade crossings with roadway closure. Utilizing electric engines instead of diesel engines will also reduce noise.</td>
<td>Train horn noise and warning bells will be eliminated with the replacement of the at-grade crossings with grade separations. Utilizing electric engines instead of diesel engines will also reduce noise. With the elevated track, train wheel noise could radiate out, which can be mitigated.</td>
<td>Train horn noise and warning bells will be eliminated with the replacement of the at-grade crossings with grade separations. The use of electric motors rather than diesel engines will also reduce noise and some road noise would be reduced. Train wheel noise at the bridge location can be mitigated.</td>
</tr>
<tr>
<td>H Maintain access to neighborhoods, parks, and schools along the corridor, while reducing regional traffic on neighborhood streets</td>
<td>Diversion of regional traffic with Churchill Ave closure will be mitigated.</td>
<td>No diversion of regional traffic with construction of a grade separations.</td>
<td>Regional traffic will be diverted due to the restricted turning movements. Pedestrian and cyclist access will significantly improve due to mode separation.</td>
</tr>
<tr>
<td>I Minimize visual changes along the corridor</td>
<td>Railroad tracks remain at existing grade. Residual roadway areas from closure provide opportunities for landscaping.</td>
<td>Railroad tracks will be approximately 20 feet above grade. Landscaping with trees will be incorporated for screening where feasible.</td>
<td>The railroad tracks and the northbound lanes of Alma St will remain at grade, and the east side of Churchill Ave will remain unchanged. Mature trees and overhead power poles within the Alma St planting only from just north of Kellogg Ave to just south of Cortege Ave, will be removed.</td>
</tr>
<tr>
<td>J Minimize disruption and duration of construction</td>
<td>The closure will have minimal road closures (nights/weekends only). Construction would last for approximately 3 years.</td>
<td>Extended lane reductions at Alma St (one lane in each direction) will be required. Construction would last for approximately 2 years.</td>
<td>Lane reductions on Alma St and Churchill Ave between Alma St and Murieta Ave will be required for the majority of construction. Total duration of construction will be approximately 2.5 to 3 years. However, the durations are subject to change depending on the construction methodologies used.</td>
</tr>
</tbody>
</table>

### Order of Magnitude Cost

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Cost Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closure</td>
<td>$50M to $65M*</td>
</tr>
<tr>
<td>Viaduct</td>
<td>$300M to $400M*</td>
</tr>
<tr>
<td>Partial Underpass</td>
<td>$160M to $200M*</td>
</tr>
</tbody>
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*Total Preliminary Construction Costs in 2018 dollars with escalation to 2025 (Subject to Change).
# Summary of Engineering Challenges

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<th>Engineering Challenges</th>
<th>Churchill</th>
</tr>
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</table>
| **L** Creek/Drainage Impacts | • Pump station required for lowered pedestrian/bike way.  
• Increased risk of flooding with pump stations.  
• Relocation of the pump house at Embarcadero Rd required to accommodate widening of Alma St.  
| Viaduct | • No significant creek or drainage impacts.  
| Partial Underpass | • Pump station required for lowered roadways.  
• Increased risk of flooding due to pump station. |
| **M** Long-Term Maintenance | Increased maintenance costs due to:  
• Pump stations for undercrossing dewatering.  
| Viaduct | Increased maintenance costs due to:  
• Above ground railroad alignment with embankments and viaduct structures.  
| Partial Underpass | Increased maintenance cost due to:  
• Pump stations for underpass dewatering.  
• Above ground structures for both road and rail. |
| **N** Utility Relocations | • Potential utility relocations in Alma St and Churchill Ave for pedestrian/bike undercrossing.  
• Minor utility relocations for Embarcadero Rd/Alma St improvements.  
| Viaduct | • Minimal impacts to utilities.  
| Partial Underpass | • Major utility relocations for lowered roadways. |
| **O** Railroad Operations Impacts during Construction | • No temporary track (i.e., shoofly) required, only single tracking during nights and weekends.  
| Viaduct | • Temporary track (i.e., shoofly) is required.  
| Partial Underpass | • Temporary track (i.e., shoofly) likely required unless alternate construction methodology and sequencing is acceptable to Caltrain. |
| **P** Local Street Circulation Impacts during Construction | • Path along Palo Alto High School will temporarily be impacted during construction.  
• Temporary night and weekend closures of lanes on Churchill Ave, Alma St and Embarcadero Rd.  
| Viaduct | • Alma St reduced to two lanes.  
• Removal of right turn lanes on Alma St at Churchill Ave; however, traffic will still be able to flow as needed despite lane reduction.  
• Temporary night and weekend closures of lanes on Alma St and Churchill Ave.  
| Partial Underpass | • Lane reduction on Alma St during construction of the shoofly and bridge.  
• Likely closure of Churchill Ave throughout the excavation and construction of the undercrossing and related features.  
• Likely closure of Kellogg Ave for the duration of the pedestrian underpass construction; driveway access from one direction only. |
| **Q** Caltrain Design Exceptions Needed | None required.  
1.6% grade on track required. Maximum grade allowed by Caltrain is 1%.  
| Viaduct | No Caltrain design exceptions needed.  
| Partial Underpass | |